

Claims:

1. An apparatus for regulating temperature of one or more temperature-sensitive components within a main enclosure, comprising:
 - a self-contained power supply;
 - one or more thermoelectric coolers;
 - a temperature sensor for measuring temperature within a temperature-controlled zone at or near the temperature-sensitive components; and
 - a temperature controller configured to regulate power supplied from the independent power supply to the thermoelectric coolers to maintain the temperature within the temperature-controlled zone within a specified range.
2. The apparatus of claim 1, wherein the self-contained power supply comprises one or more batteries.
3. The apparatus of claim 2, wherein the apparatus further comprises one or more solar cells adapted to charge the one or more batteries.
4. The apparatus of claim 1, wherein the temperature controlled zone is defined by an inner enclosure.
5. The apparatus of claim 4, wherein the inner enclosure is made of a thermally conductive material.
6. The apparatus of claim 5, further comprising one or more heat exchangers thermally coupled with the thermoelectric coolers.
7. The apparatus of claim 6, wherein the inner enclosure is thermally coupled to the one or more heat exchangers via the thermoelectric coolers.

8. The apparatus of claim 7, wherein contact surfaces of the inner enclosure thermally coupled with the thermoelectric coolers are spaced to minimize regions of high temperature in the heat exchangers.
9. The apparatus of claim 7, wherein the temperature-sensitive components are thermally coupled to the inner enclosure with a thermal interface material.
10. The apparatus of claim 1, further comprising an insulative material disposed within the main enclosure.
11. The apparatus of claim 6, wherein the heat exchangers are attached to exterior walls of the main enclosure.
12. The apparatus of claim 1, wherein the temperature controller is configured to regulate power supplied from the independent power supply to the at least one thermoelectric cooler by varying a duty cycle of a pulse width modulated signal.
13. The apparatus of claim 1, wherein the temperature controller is configured to:
supply the thermoelectric coolers with a voltage signal having a first polarity to cool the temperature-sensitive components; and
supply the thermoelectric coolers with a voltage signal having a second polarity, opposite the first polarity, to heat the temperature-sensitive components.
14. The apparatus of claim 1, further comprising a thermal switch responsive to a temperature within the temperature controlled zone, wherein power is removed from the at least one thermal electric cooler in response to the thermal switch changing states.
15. The apparatus of claim 1, wherein the apparatus is capable of maintaining a temperature within the temperature controlled zone within a range of approximately .3 degrees Celsius peak to peak within a predefined target temperature.

16. The apparatus of claim 1, wherein the controller is configured to maintain the temperature of the temperature-sensitive components at or above an anticipated dewpoint for a geographic area in which the apparatus is deployed or is to be deployed.
17. An apparatus for maintaining a temperature of one or more temperature-sensitive components within a main enclosure, comprising:
one or more solid state cooling devices;
a thermally conductive manifold positioned to conduct heat from the temperature-sensitive components to the solid state cooling devices;
a temperature sensor for measuring temperature at or near the one or more temperature-sensitive components; and
a temperature controller configured to generate a signal to the solid state cooling devices to maintain the temperature at or near the temperature-sensitive components within a specified range.
18. The apparatus of claim 17, wherein the manifold is thermally coupled to one or more heat exchangers on the exterior of the main enclosure, via the one or more solid state cooling devices.
19. The apparatus of claim 17, wherein the manifold is shaped to minimize convective transfer of heat from the manifold to the interior of the main enclosure.
20. The apparatus of claim 19, wherein the manifold comprises one or more protrusions, each having a contact surface shaped to mate with one of the solid state cooling devices, wherein the protrusions are configured to evenly distribute heat among fins of the heat exchangers.
21. A fiber optic sensing system, comprising:

one or more fiber optic sensors for sensing one or more downhole parameters;

one or more optical signal processing components optically coupled to the one or more fiber optic sensors via one or more optical fibers; and

a temperature controlled enclosure housing the one or more optical signal processing components, one or more thermoelectric coolers thermally coupled with at least one of the optical signal processing components, a temperature sensor for measuring temperature at or near the optical signal processing components, and a temperature controller configured to vary power supplied to the thermoelectric coolers based on a signal from the temperature sensor.

22. The system of claim 21, wherein the temperature controller is configured to vary power supplied to the thermoelectric coolers by varying a duty cycle of a pulse width modulated signal.

23. The system of claim 21, wherein the temperature controller is configured to supply the thermoelectric coolers with a voltage signal of a first polarity to cool the temperature-sensitive components and a voltage signal of a second polarity, opposite the first polarity, to heat the temperature-sensitive components.

24. The system of claim 21, wherein the optical signal processing components are thermally coupled with the thermoelectric coolers via at least one thermally conductive manifold.

25. The system of claim 24, further comprising one or more heat exchangers disposed on an exterior of the enclosure and thermally coupled to the thermoelectric coolers.

26. The system of claim 25, wherein the thermoelectric coolers are spaced to evenly distribute heat across fins of the heat exchangers.

27. The system of claim 26, wherein the at least one thermally conductive manifold comprises a plurality of protrusions, each having a contact surface for mating with a corresponding thermoelectric cooler.
28. The system of claim 24, further comprising a thermal interface material disposed between the optical signal processing components and the thermally conductive manifolds via a thermal interface.
29. The system of claim 21, further comprising:
a bank of one or more batteries for supplying power to components within the enclosure; and
an array of one or more solar panels for maintaining a charge on the bank of one or more batteries.
30. The system of claim 29, wherein the array of one or more solar panels is positioned to shade the enclosure.
31. A method of regulating temperature of one or more temperature-sensitive components within an enclosure, comprising the steps of:
thermally coupling the temperature-sensitive components to one or more thermoelectric coolers;
measuring temperature at or near the temperature-sensitive components; and
varying power supplied to thermoelectric coolers thermally coupled with at least one of the temperature-sensitive components, in response to the measured temperature.
32. The method of claim 31, wherein thermally coupling the temperature-sensitive components to one or more thermoelectric coolers comprises thermally coupling the temperature-sensitive components to at least one thermally conductive manifold thermally coupled with the thermoelectric coolers.

33. The method of claim 32, further comprising thermally coupling the thermoelectric coolers to one or more heat exchangers disposed on an exterior of the enclosure.

34. The method of claim 31, wherein varying power supplied to thermoelectric coolers in response to the measured temperature comprises performing a proportional-integral-differential control algorithm, using the measured temperature as feedback.

35. The method of claim 34, wherein varying power supplied to thermoelectric coolers comprises varying a duty cycle of a pulse width modulated signal.

36. The method of claim 31, wherein varying power supplied to thermoelectric coolers in response to the measured temperature comprises:

applying a voltage signal of a first polarity to the thermoelectric coolers to cool the temperature sensitive components; and

applying a voltage signal of a second polarity to the thermoelectric coolers to heat the temperature-sensitive components, wherein the second polarity is opposite the first polarity.